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1 JUNE 1964

PROPERTIES OF PHOTODETECTORS

PHOTODETECTOR SERIES, 61ST REPORT

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FOREWORD

This report, which was prepared as part of the Joint Services Infrared Sensitive Element Testing Program, is one of a series that consists of a collection of data sheets presenting various physical properties of photodetectors. The work reported here was performed from September 1963 through April 1964. It was authorized by WepTask RMGA-41-049/211-1/R008-03-002 and covered by the following funds:

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CONTENTS

INTRODUCTION

This report presents the results of measurements made on ten photodetectors. It includes data sheets on lead sulfide cells from Infrared Industries, Inc; indium antimonide cells from the Santa Barbara Research Center, Davers Corporation, and Minneapolis-Honeywell; germanium cells from the Santa Barbara Research Center; and a thermocouple from Beckman Instruments, Inc.

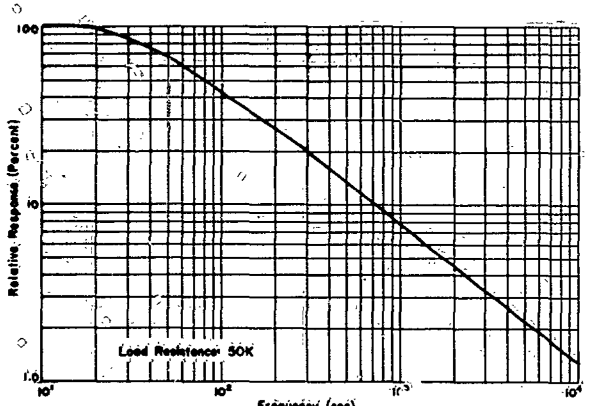
A summary of the data obtained is given in Table 1.

TABLE 1. Summary of Data

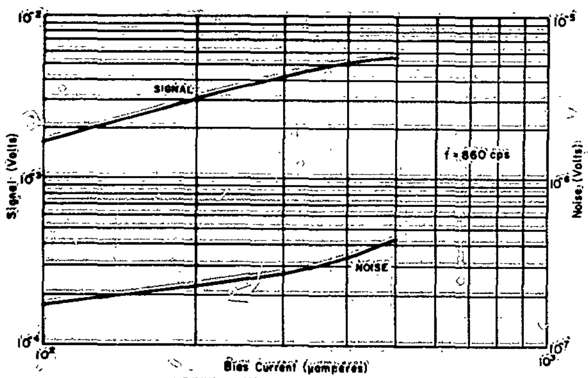
Data sheet No.	Cell type	Cell No.[1]	Area (cm^2)	Cell temp. (°K)	Blackbody response (500, 860): R, responsivity (volts/watt)	Blackbody response (500, 860): H_N, noise equivalent irradiance $\left(\frac{watts}{cps^{\frac{1}{2}} \cdot cm^2}\right)$	Blackbody response (500, 860): P_N, noise equivalent power $\left(watts/cps^{\frac{1}{2}}\right)$	Blackbody response (500, 860): D* $\left(\frac{cm \cdot cps^{\frac{1}{2}}}{watt}\right)$	Responsive time constant (μsec)	$\frac{R_{\lambda max}}{R_{bb}}$	Peak wave-length (μ)	Peak detective modulation frequency (cps)	D^*_{mm} $\left(\frac{cm \cdot cps^{\frac{1}{2}}}{watt}\right)$
792	PbS	IRI A	5.0×10^{-2}	77	9.1×10^{3}	6.1×10^{-10}	3.0×10^{-11}	7.4×10^{9}	3.4×10^{3}	22	2.4	7×10^{2}	1.9×10^{11}
793	PbS	IRI B	1.2×10^{-1}	77	3.5×10^{3}	5.1×10^{-10}	6.2×10^{-11}	5.6×10^{9}	5.6×10^{3}	20	2.6	7×10^{2}	1.5×10^{11}
794	InSb	SBRC CM0111	4.3×10^{-4}	77	2.0×10^{5}	4.8×10^{-9}	3.0×10^{-12}	8.4×10^{9}	9	17	4.6	4×10^{3}	1.7×10^{11}
795	InSb	SBRC 62-4-35	1.5×10^{-3}	77	4.6×10^{5}	7.6×10^{-10}	1.2×10^{-12}	3.4×10^{10}	7	5.4	5.0	$> 10^{4}$	2.3×10^{11}
796	InSb	SBRC W281-D	2.5×10^{-3}	77	4.3×10^{4}	2.4×10^{-9}	5.9×10^{-12}	8.5×10^{9}	7	5.7	5.4	$> 10^{4}$	6.4×10^{10}
797	InSb	DC 0964	4.9×10^{-2}	77	2.4×10^{4}	2.1×10^{-10}	1.0×10^{-11}	2.1×10^{10}	< 1	5.2	4.5	$> 2 \times 10^{2}$	1.1×10^{11}
798	InSb	MH 01	1.18	77	3.7×10^{3}	8.3×10^{-11}	9.7×10^{-11}	1.1×10^{10}	4	5.2	5.0	$> 10^{4}$	8.0×10^{10}
799	Ge (Hg-doped)	SBRC A	7.8×10^{-3}	4	1.8×10^{5}	1.9×10^{-9}	1.5×10^{-11}	6.0×10^{9}	< 1	1.7	10.4	$> 10^{4}$	1.1×10^{10}
800	Ge (Hg-doped)	SBRC 22-8	7.8×10^{-3}	4	1.3×10^{5}	2.5×10^{-9}	2.0×10^{-11}	4.5×10^{9}	< 1	1.8	11.2	$> 10^{4}$	9.4×10^{9}
801	Thermocouple	BI 2352	6.9×10^{-3}	296	1.1†	1.9×10^{-8}†	1.3×10^{-10}†	6.5×10^{8}†	1.9×10^{4}	1.1	1.8	< 2	1.1×10^{9}

[1] Abbreviations: IRI—Infrared Industries, Inc.; SBRC—Santa Barbara Research Center; DC—Davers Corp.; MH—Minneapolis-Honeywell; BI—Beckman Instruments, Inc.

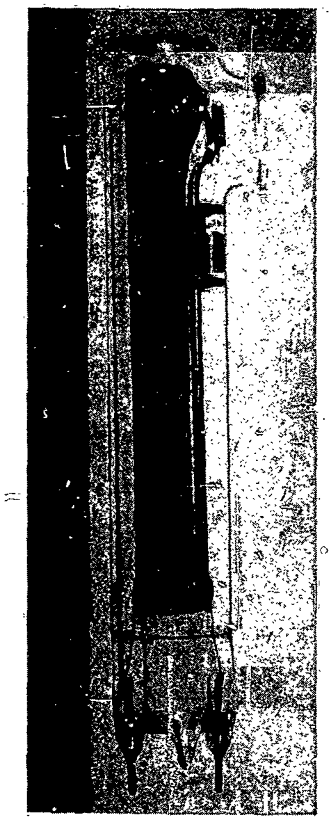
†Blackbody response measured at 500,10.

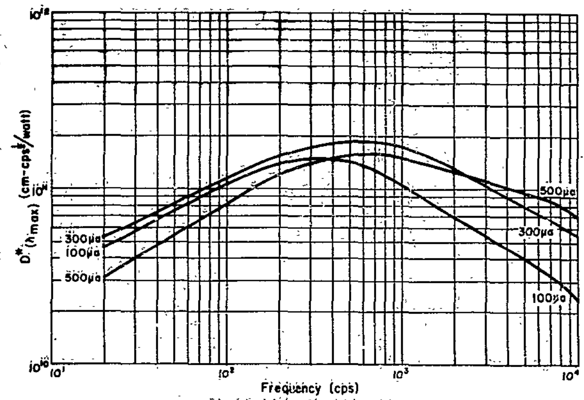


FREQUENCY RESPONSE



DETERMINATION OF OPTIMUM BIAS





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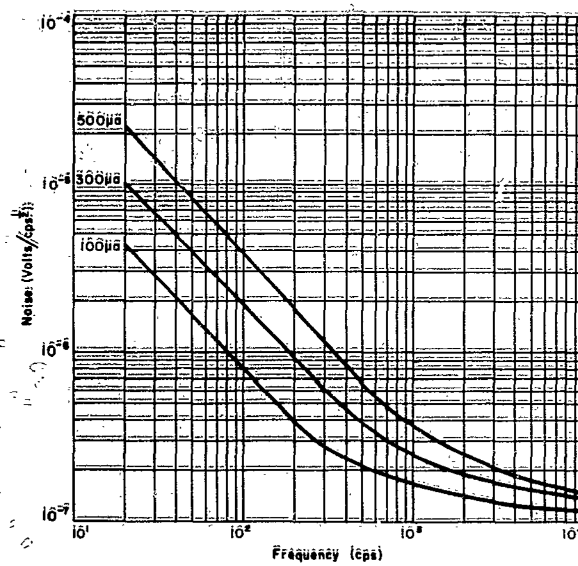


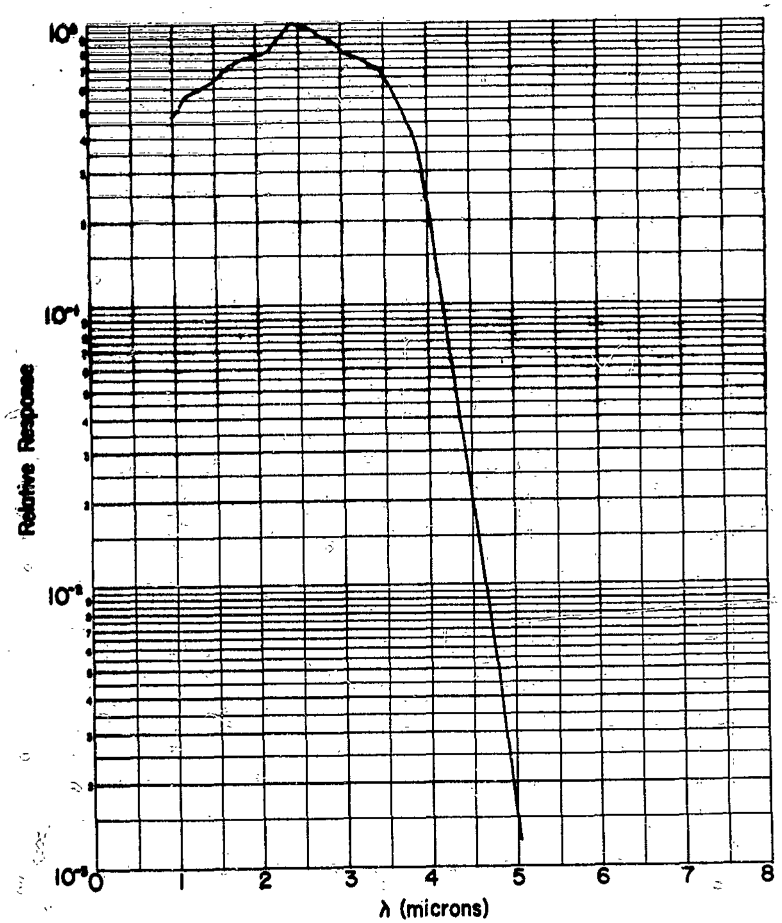
NOISE SPECTRUM

Infrared Industries Cell A, PbS
Data Sheet No. 792-A, September 1963

TEST RESULTS	
R (volts/watt) (500, 860)	9.1×10^{3}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	6.1×10^{-10}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	3.0×10^{-11}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	7.4×10^{9}
Responsive time constant (μsec)	3.4×10^{3}
$\frac{R_{\lambda max}}{R_{bb}}$	22
Peak wavelength (μ)	2.4
Peak detective modulation frequency (cps)	7.0×10^{2}
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	1.9×10^{11}

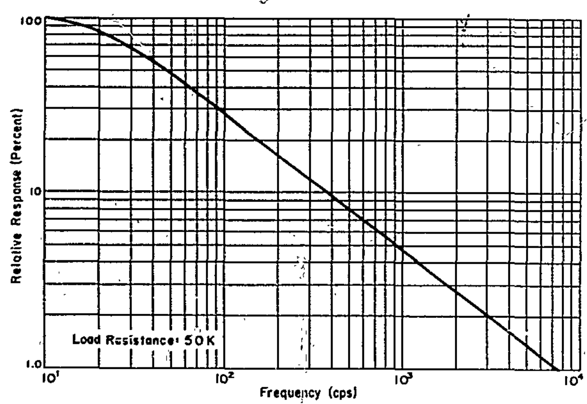
CELL DESCRIPTION	
Type	PbS
Shape of sensitive area (cm)	0.10 × 0.50
Area (cm^2)	5.0×10^{-2}
Dark resistance (ohms)	2.5×10^{5}
Dynamic resistance (ohms)	---
Field of view	---
Window material	Sapphire

CONDITIONS OF MEASUREMENT	
Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	300
Cell current for D^*_{mm} (μa)	300
Load resistance (ohms)	2.5×10^{5}
Transformer	---
Relative humidity (%)	37
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only



SPECTRAL RESPONSE

Infrared Industries Cell A, PbS
Data Sheet No. 792-B, September 1963



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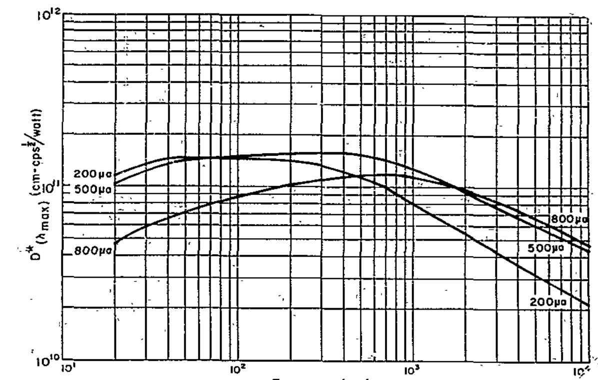

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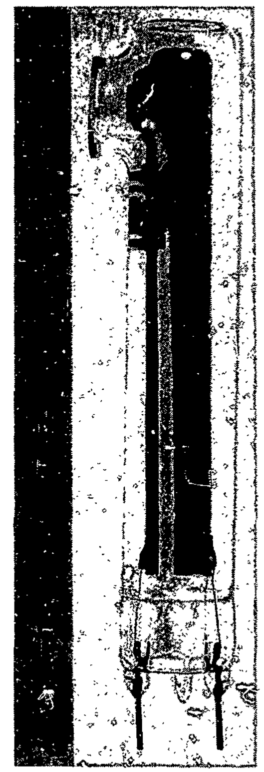
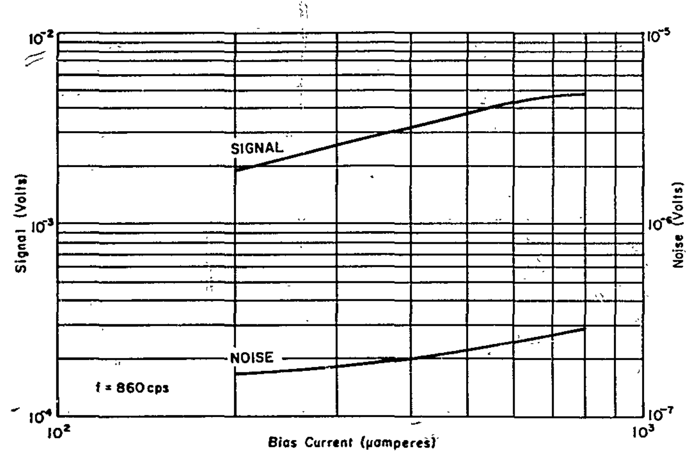
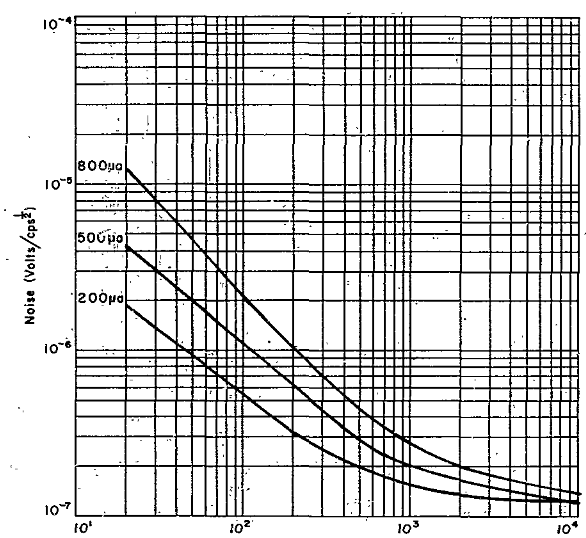




DETERMINATION OF OPTIMUM BIAS



NOISE SPECTRUM

Infrared Industries Cell B, PbS
Data Sheet No. 793-A, October 1963

TEST RESULTS

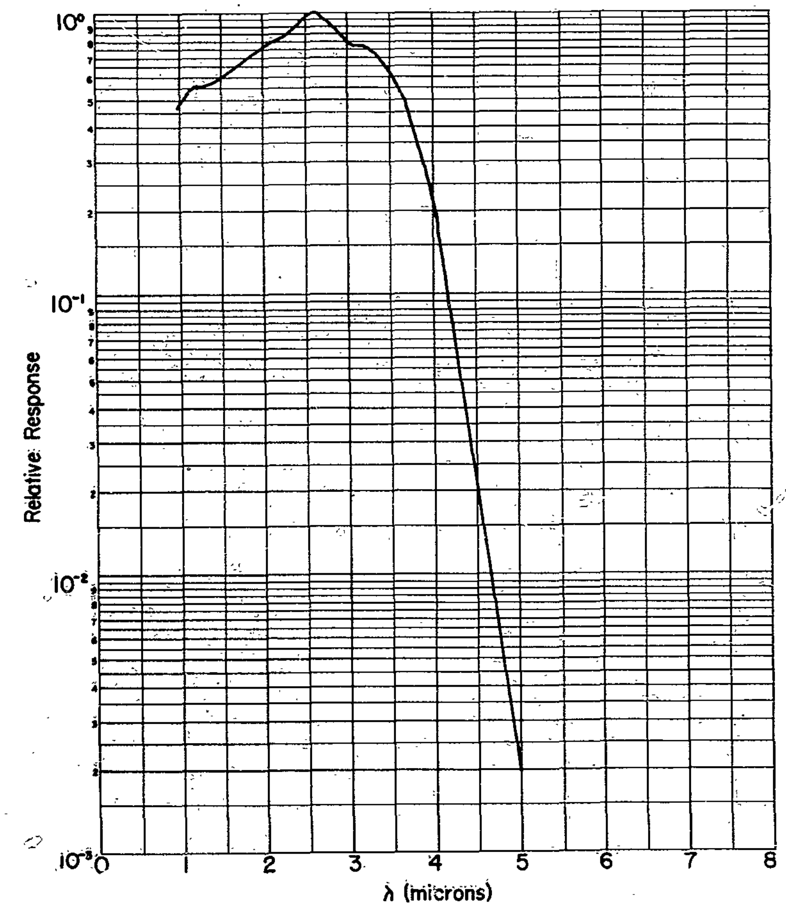
R (volts/watt) (500, 860)	3.5×10^{3}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	5.1×10^{-10}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	6.2×10^{-11}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	5.6×10^{9}
Responsive time constant (μsec)	5.6×10^{3}
$\frac{R_{\lambda max}}{R_{bb}}$	20
Peak wavelength (μ)	2.6
Peak detective modulation frequency (cps)	7.0×10^{2}
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	1.5×10^{11}

CELL DESCRIPTION

Type	PbS
Shape of sensitive area (cm)	0.244×0.50
Area (cm^2)	1.22×10^{-1}
Dark resistance (ohms)	2.6×10^{4}
Dynamic resistance (ohms)	---
Field of view	---
Window material	Sapphire

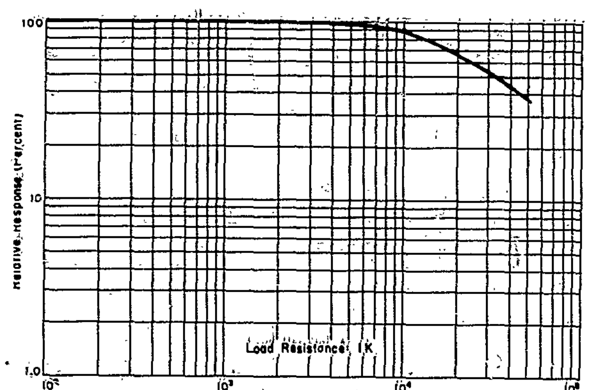
CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	500
Cell current for D^*_{mm} (μa)	500
Load resistance (ohms)	2.5×10^{4}
Transformer	---
Relative humidity (%)	41
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only



SPECTRAL RESPONSE

Infrared Industries Cell B; PbS
Data Sheet No. 793-B; October 1963



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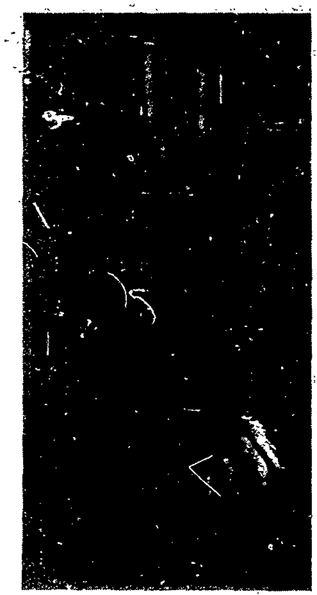
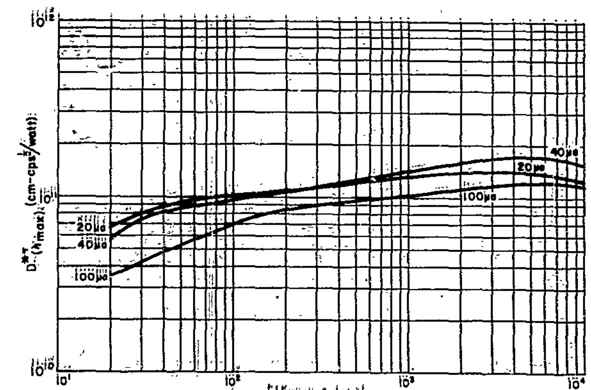
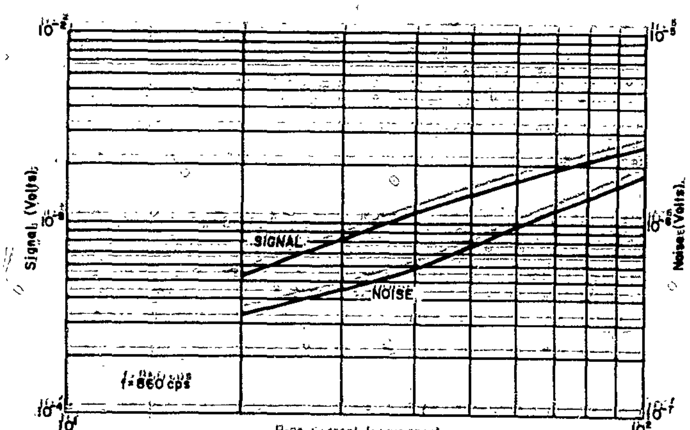
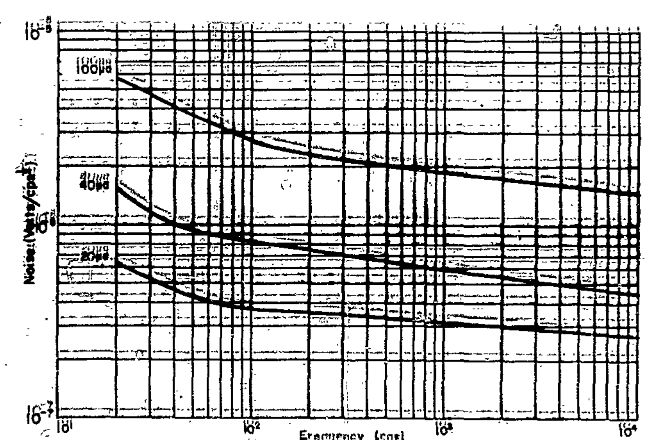




DETECTIVITY VS FREQUENCY



DETERMINATION OF OPTIMUM BIAS



NOISE SPECTRUM

Santa Barbara Research Center Cell GM0111, InSb
Data Sheet No. 794-A, September 1963

TEST RESULTS

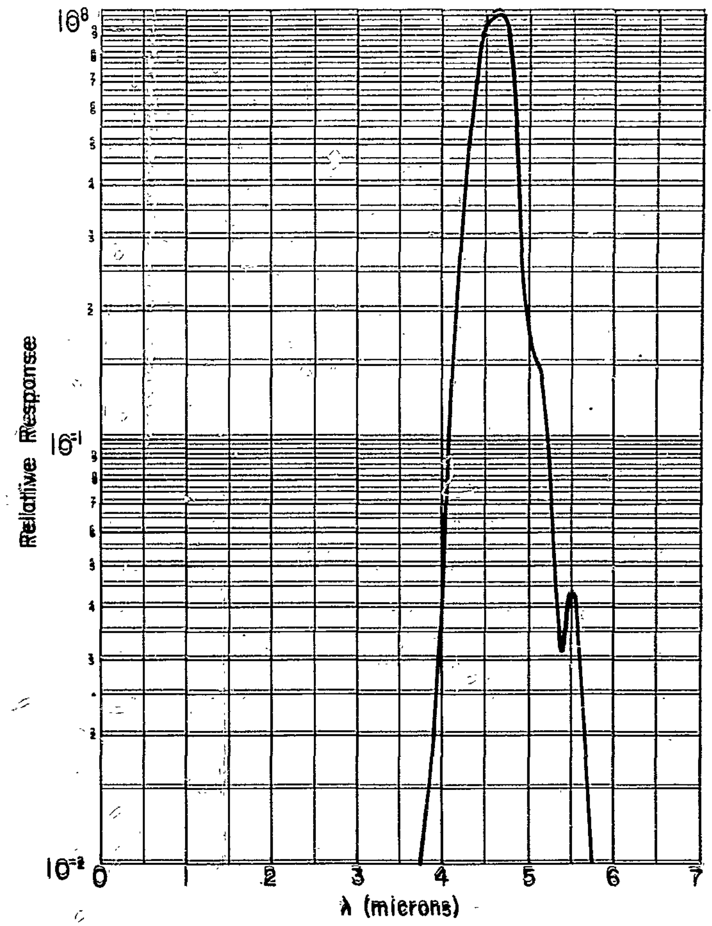
R (volts/watt) (500, 860)	2.0×10^{5}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	4.8×10^{-9}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	3.0×10^{-12}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	8.4×10^{9}
Responsive time constant (μsec)	9.0
$\frac{R_{\lambda max}}{R_{bb}}$	17
Peak wavelength (μ)	4.6
Peak detective modulation frequency (cps)	4×10^{3}
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	1.7×10^{11}

CELL DESCRIPTION

Type	InSb
Shape of sensitive area (cm)	0.00635 × 0.099
Area (cm^2)	6.3×10^{-4}
Dark resistance (ohms)	4.1×10^{3}
Dynamic resistance (ohms)	---
Field of view	30°
Window material	Silicon plus cold interference filter

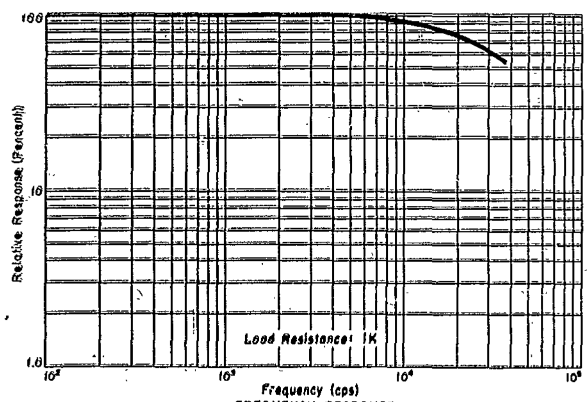
CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	40
Cell current for D^*_{mm} (μa)	40
Load resistance (ohms)	5×10^{4}
Transformer	---
Relative humidity (%)	39
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	297°K only



SPECTRAL RESPONSE

Santa Barbara Research Center Cell CM0111, InSb
Data Sheet No. 794-B, September 1963



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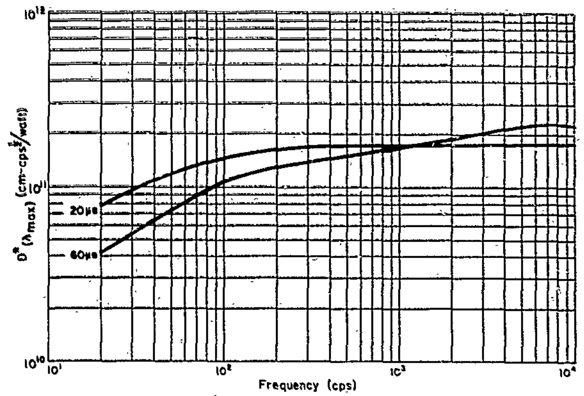
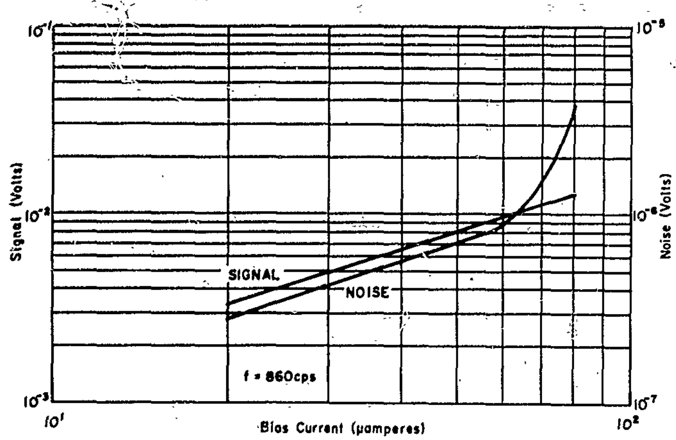
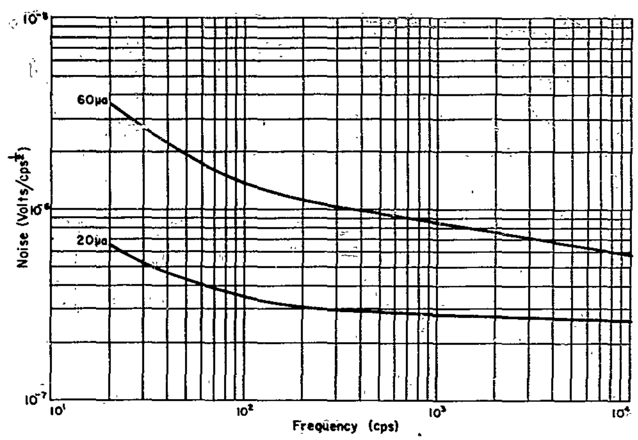


DETECTIVITY VS FREQUENCY



DETERMINATION OF OPTIMUM BIAS



NOISE SPECTRUM

Santa Barbara Research Center Cell 62-4-35, InSb
Data Sheet No. 795-A, January 1964

TEST RESULTS

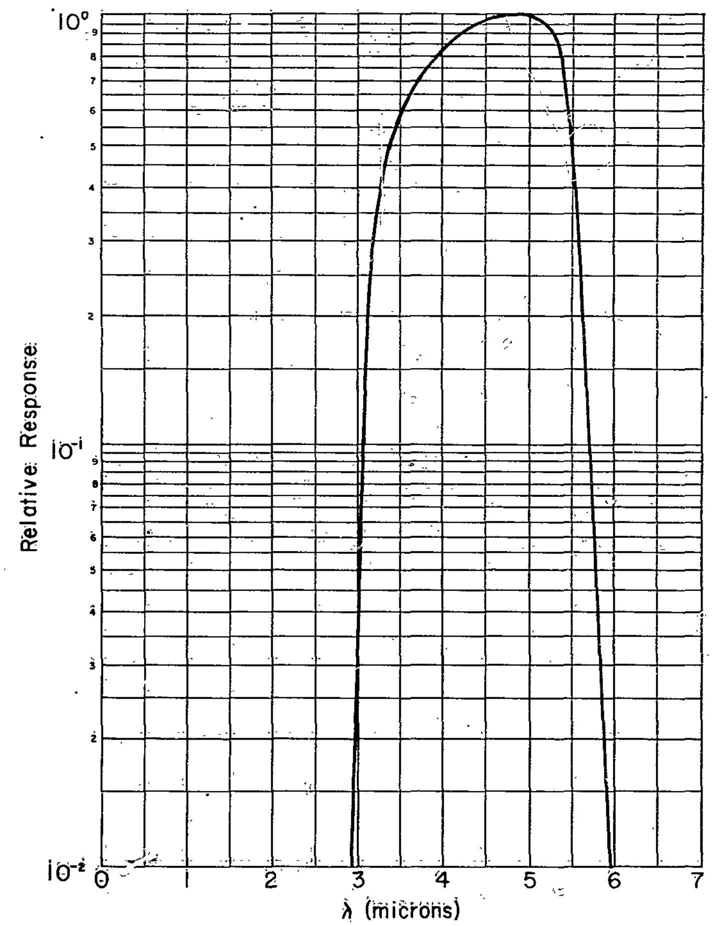
R (volts/watt) (500, 860)	4.6×10^{5}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	7.6×10^{-10}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	1.2×10^{-12}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	3.4×10^{10}
Responsive time constant (μsec)	7
$\frac{R_{\lambda max}}{R_{bb}}$	5.4
Peak wavelength (μ)	5.0
Peak detective modulation frequency (cps)	$> 10^4$
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	2.3×10^{11}

CELL DESCRIPTION

Type	InSb
Shape of sensitive area (cm)	0.01×0.15
Area (cm^2)	1.5×10^{-3}
Dark resistance (ohms)	8.0×10^{4}
Dynamic resistance (ohms)	---
Field of view	30°
Window material	Silicon plus cold interference filter

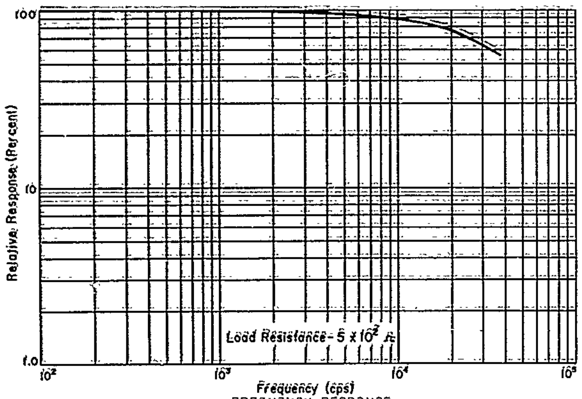
CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	40
Cell current for D^*_{mm} (μa)	60
Load resistance (ohms)	1.0×10^{5}
Transformer	---
Relative humidity (%)	29
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only



SPECTRAL RESPONSE

Santa Barbara Research Center Cell 62-4-35; InSb
Data Sheet No. 795-B, January 1964



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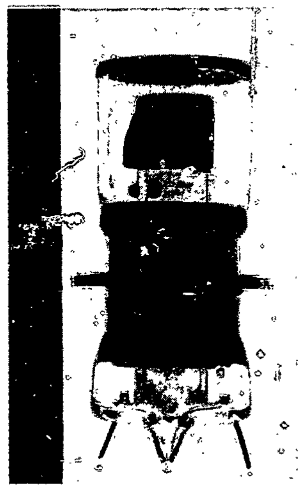
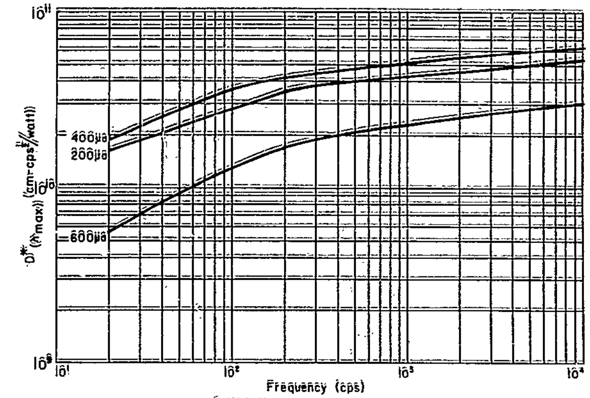
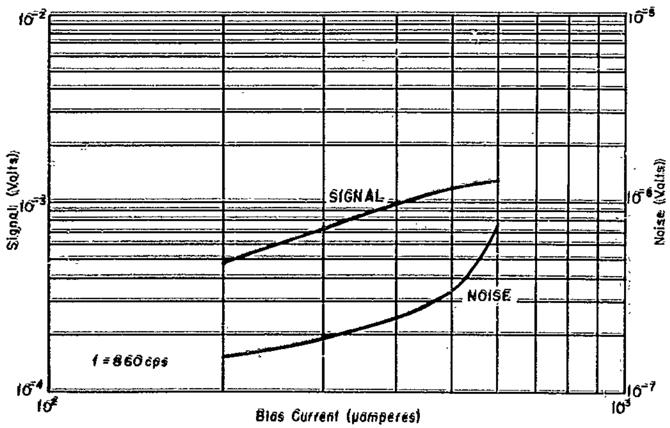
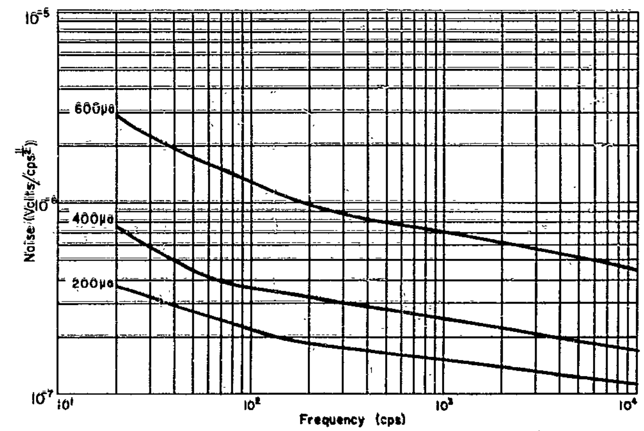




DETECTIVITY VS FREQUENCY



DETERMINATION OF OPTIMUM BIAS



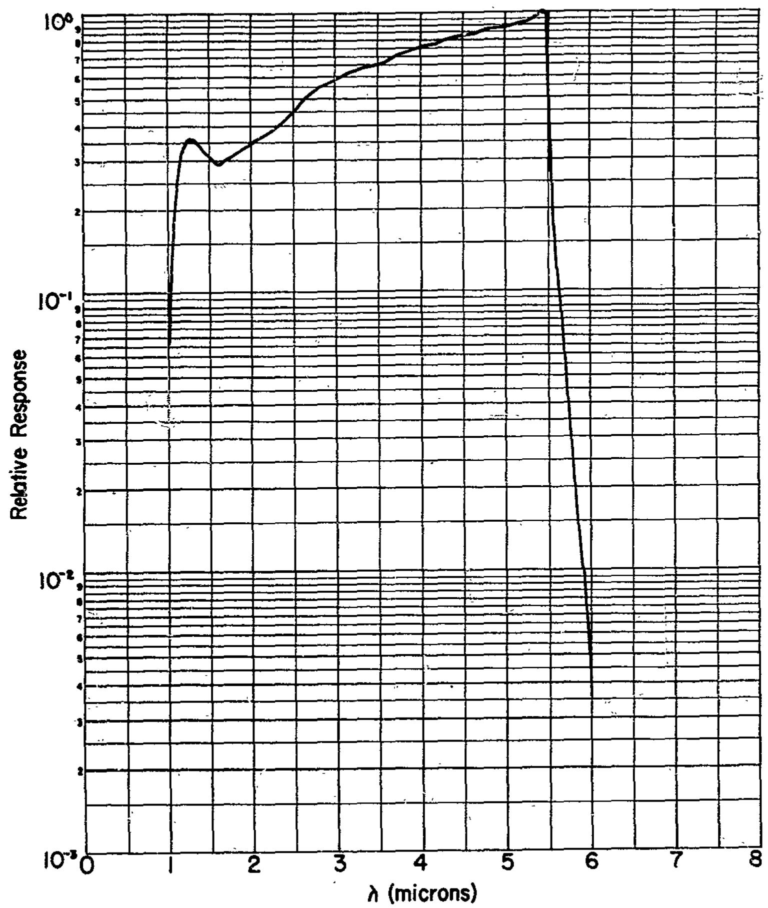
NOISE SPECTRUM

Santa Barbara Research Center Cell W281-D, InSb
Data Sheet No. 796-A, September 1963

TEST RESULTS	
R (volts/watt) (500, 860)	4.3×10^{4}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	2.4×10^{-9}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	5.9×10^{-12}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	8.5×10^{9}
Responsive time constant (μsec)	7.0
$\frac{R_{\lambda max}}{R_{bb}}$	5.7
Peak wavelength (μ)	5.4
Peak detective modulation frequency (cps)	$> 10^{4}$
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	6.4×10^{10}

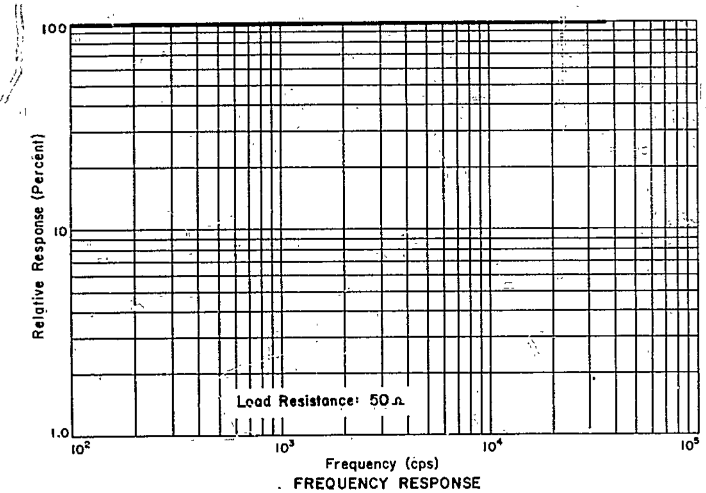
CELL DESCRIPTION	
Type	InSb
Shape of sensitive area (cm)	0.05 × 0.05
Area (cm^2)	2.5×10^{-3}
Dark resistance (ohms)	3.9×10^{3}
Dynamic resistance (ohms)	---
Field of view	60°
Window material	Silicon

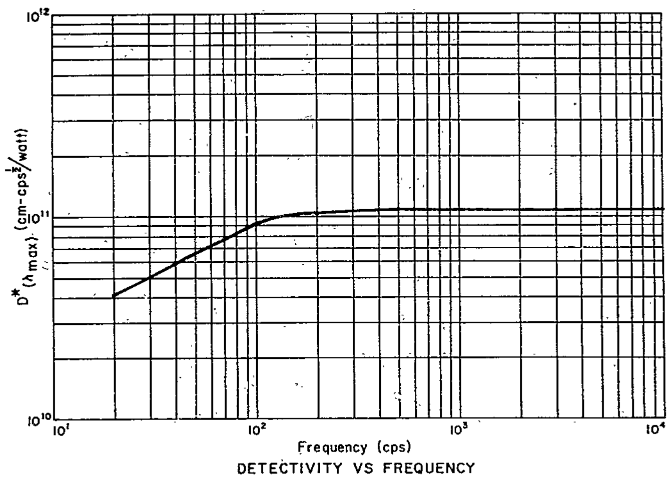
CONDITIONS OF MEASUREMENT	
Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	400
Cell current for D^*_{mm} (μa)	400
Load resistance (ohms)	5.0×10^{3}
Transformer	---
Relative humidity (%)	39
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only

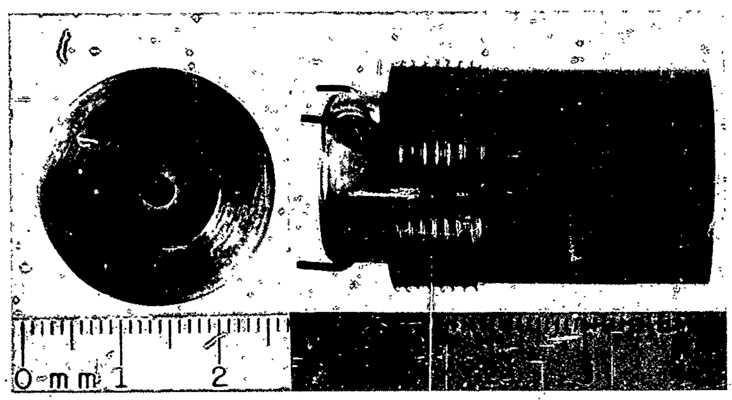


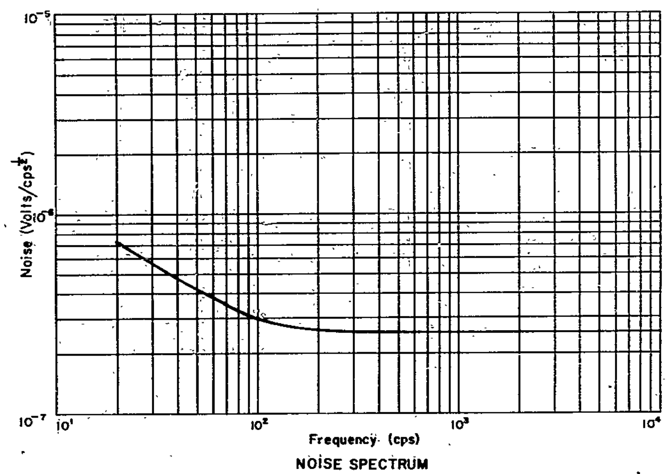
SPECTRAL RESPONSE

Santa Barbara Research Center Cell W281-D, InSb
Data Sheet No. 796-B, September 1963







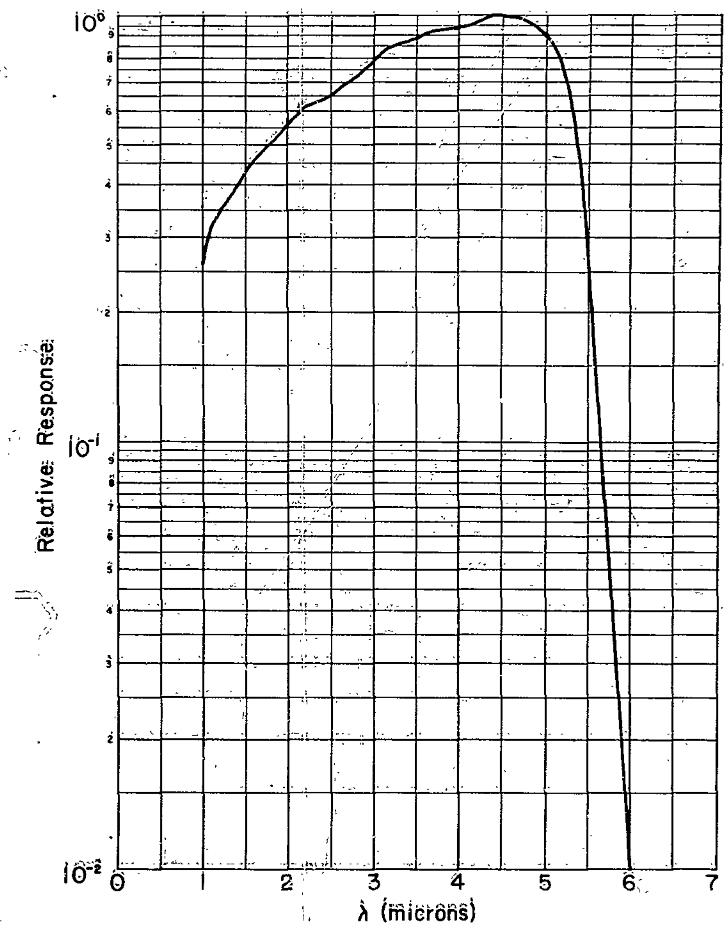


Davers Corporation Cell 0964, InSb
Data Sheet No. 797-A, December 1963

TEST RESULTS	
R (volts/watt) (500, 860)	2.4×10^{4}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	2.1×10^{-10}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	1.0×10^{-11}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	2.1×10^{10}
Responsive time constant (μsec)	< 1
$\frac{R_{\lambda max}}{R_{bb}}$	5.2
Peak wavelength (μ)	4.5
Peak detective modulation frequency (cps)	> 200
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	1.1×10^{11}

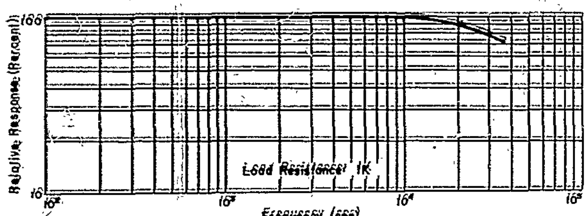
CELL DESCRIPTION	
Type	InSb
Shape of sensitive area (cm)	0.25 diam.
Area (cm^2)	4.9×10^{-2}
Dark resistance (ohms)	---
Dynamic resistance (ohms)	2.0×10^{4}
Field of view	≈80°
Window material	Sapphire

CONDITIONS OF MEASUREMENT	
Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	---
Cell current for D^*_{mm} (μa)	---
Load resistance (ohms)	---
Transformer UTC A-27; 500/100 K	
Relative humidity (%)	25
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only

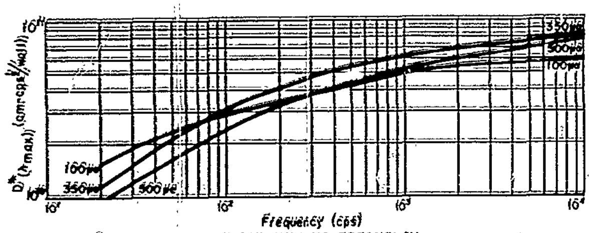


SPECTRAL RESPONSE

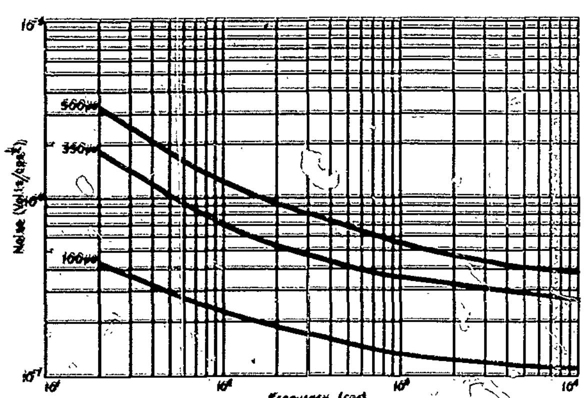
Davers Corporation Cell 0964; InSb
Data Sheet No. 797-B; December 1963



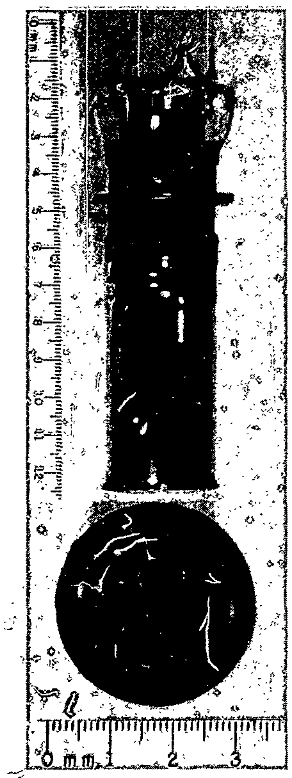
FREQUENCY RESPONSE

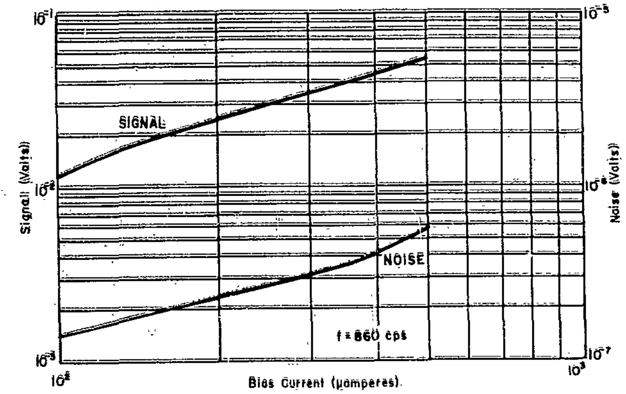


DETECTIVITY VS FREQUENCY

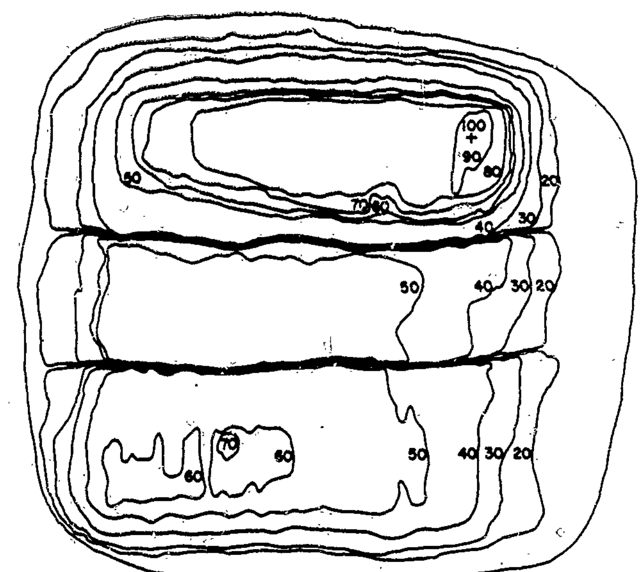


NOISE SPECTRUM





DETERMINATION OF OPTIMUM BIAS



SENSITIVITY CONTOUR

Minneapolis-Honeywell Cell 01, InSb
Data Sheet No. 798-A, January 1964

TEST RESULTS

R (volts/watt) (500, 860)	3.7×10^{3}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	8.3×10^{-11}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	9.7×10^{-11}
D^* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	1.1×10^{10}
Responsive time constant (μsec)	4
$\frac{R_{\lambda max}}{R_{bb}}$	5.2
Peak wavelength (μ)	5.0
Peak detective modulation frequency (cps)	$> 10^4$
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	8.0×10^{10}

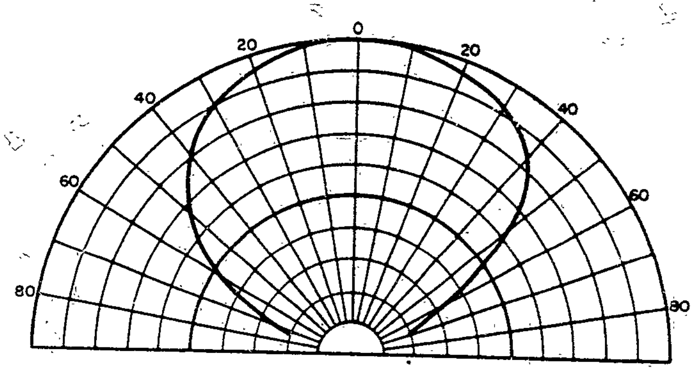
CELL DESCRIPTION

Type	InSb
Shape of sensitive area (cm)	0.34×1.12†
Area (cm^2)	1.18
Dark resistance (ohms)	7.1×10^4
Dynamic resistance (ohms)	---
Field of view	≈90°
Window material	Sapphire

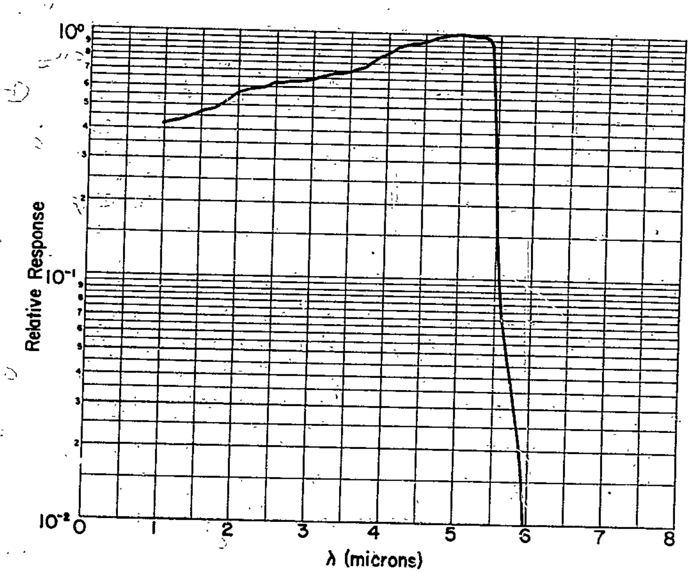
CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	77
Cell current for 860-cps data (μa)	350
Cell current for D^*_{mm} (μa)	350
Load resistance (ohms)	5.0×10^4
Transformer	---
Relative humidity (%)	26
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only

†Detector consisted of three sensitive areas of equal size and shape.

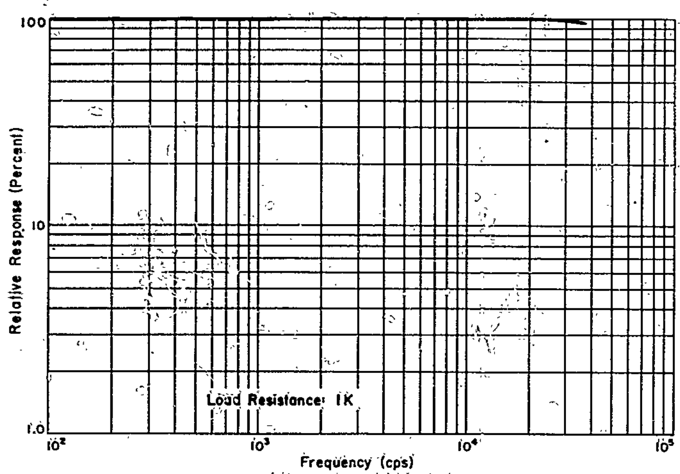


FIELD OF VIEW



SPECTRAL RESPONSE

Minneapolis-Honeywell Cell 01, InSb
Data Sheet No. 798-B, January 1964



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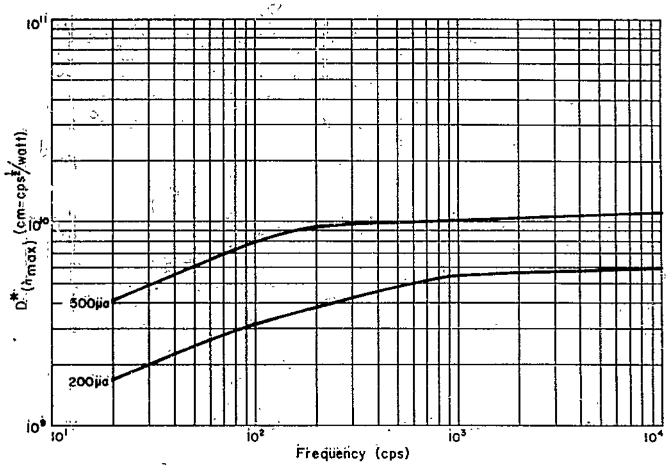
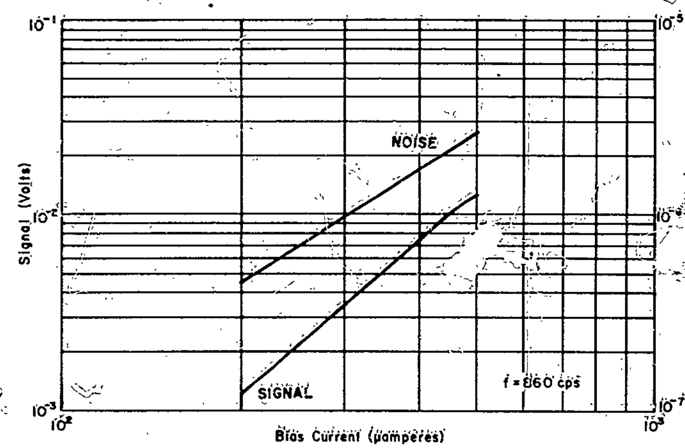
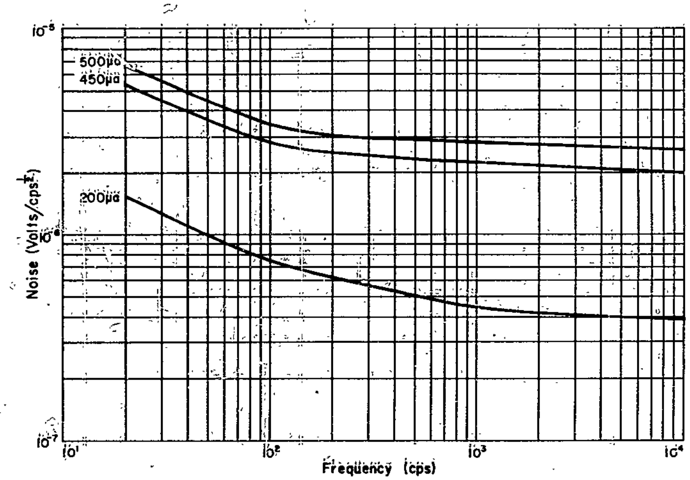


DETECTIVITY VS FREQUENCY



DETERMINATION OF OPTIMUM BIAS



NOISE SPECTRUM

Santa Barbara Research Center Cell A; Ge
Data Sheet No. 799-A, September 1963

TEST RESULTS

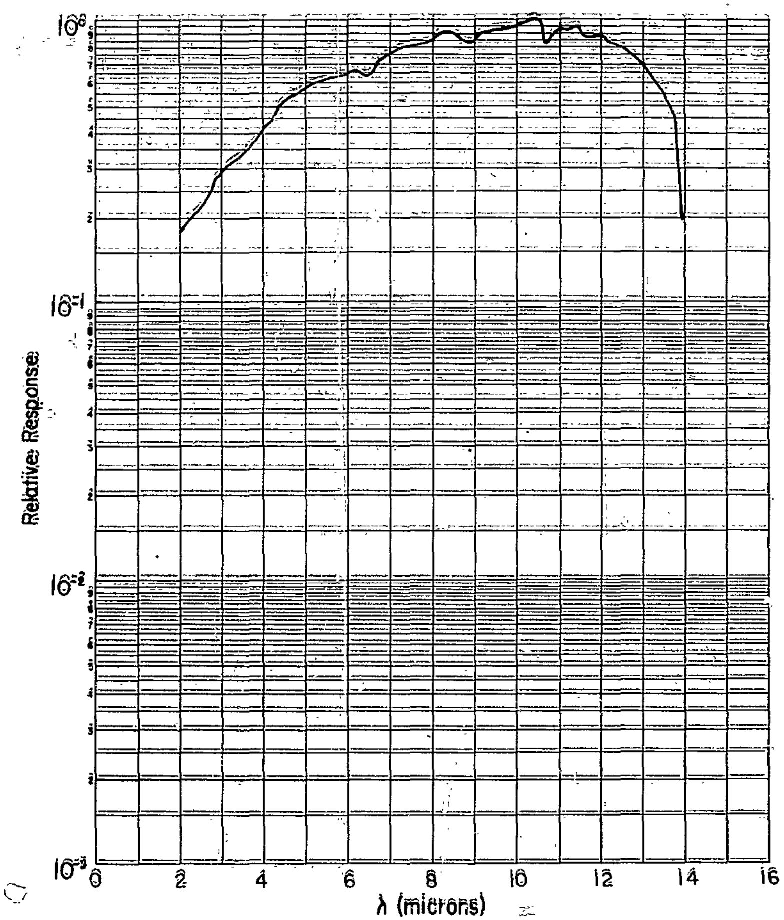
R (volts/watt) (500, 860)	1.8×10^{5}
H_N (watts/cps$^{1/2}$·cm^2) (500, 860)	1.9×10^{-9}
P_N (watts/cps$^{1/2}$) (500, 860)	1.5×10^{-11}
D* (cm·cps$^{1/2}$/watt) (500, 860)	6.0×10^{9}
Responsive time constant (μsec)	< 1
$\frac{R_{\lambda max}}{R_{bb}}$	1.7
Peak wavelength (μ)	10.4
Peak detective modulation frequency (cps)	$> 10^{4}$
D^*_{mm} (cm·cps$^{1/2}$/watt)	1.1×10^{10}

CELL DESCRIPTION

Type	Ge (Hg-doped)
Shape of sensitive area (cm)	0.10 diam.
Area (cm^2)	7.8×10^{-3}
Dark resistance (ohms)	3.2×10^{4}
Dynamic resistance (ohms)	---
Field of view	≈150°
Window material	Irtran II

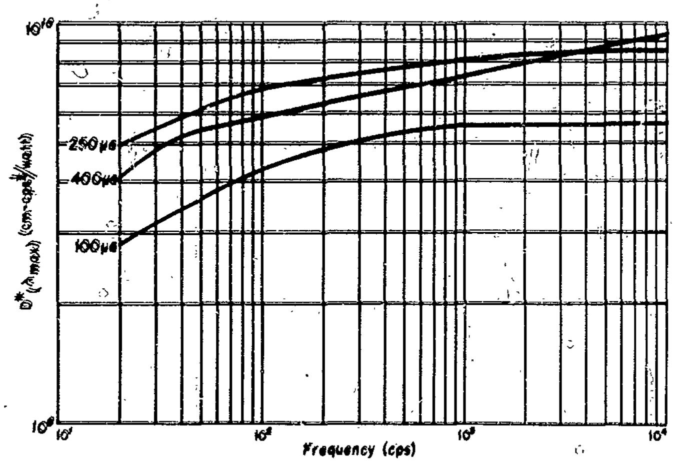
CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2; rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	4
Cell current for 860-cps data (μa)	500
Cell current for D^*_{mm} (μa)	500
Load resistance (ohms)	2.5×10^{4}
Transformer	---
Relative humidity (%)	39
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only

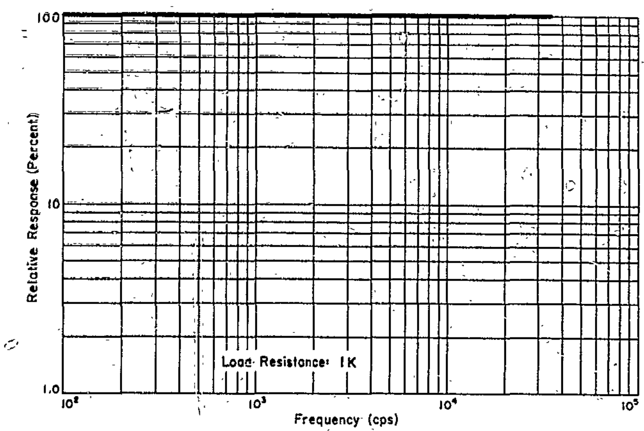


SPECTRAL RESPONSE

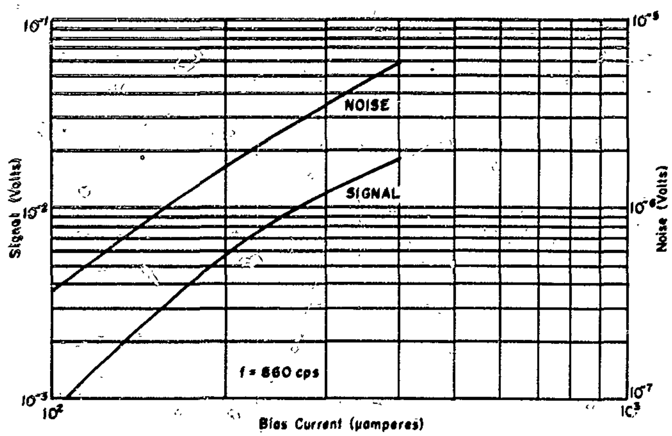
Santa Barbara Research Center Cell A, Ge
Data Sheet No. 799-B, September 1963



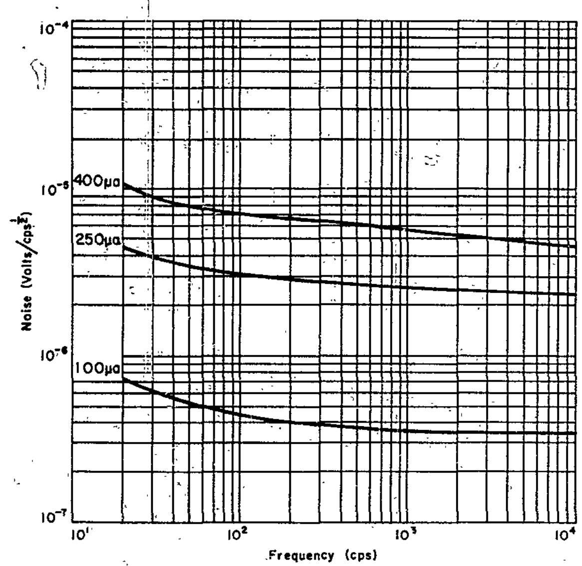
DETECTIVITY VS FREQUENCY



FREQUENCY RESPONSE



DETERMINATION OF OPTIMUM BIAS



NOISE SPECTRUM

Santa Barbara Research Center Cell 22-8, Ge
Data Sheet No. 800-A, April 1964

TEST RESULTS

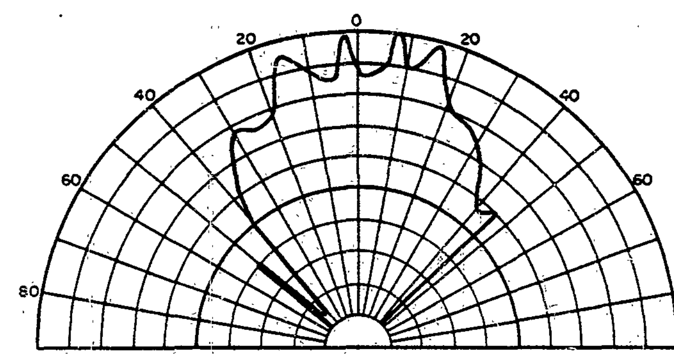
R (volts/watt) (500, 860)	1.3×10^{5}
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 860)	2.5×10^{-9}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 860)	2.0×10^{-11}
D* (cm·cps$^{\frac{1}{2}}$/watt) (500, 860)	4.5×10^{9}
Responsive time constant (μsec)	< 1
$\frac{R_{\lambda max}}{R_{bb}}$	1.8
Peak wavelength (μ)	11.2
Peak detective modulation frequency (cps)	$> 10^{4}$
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	9.4×10^{9}

CELL DESCRIPTION

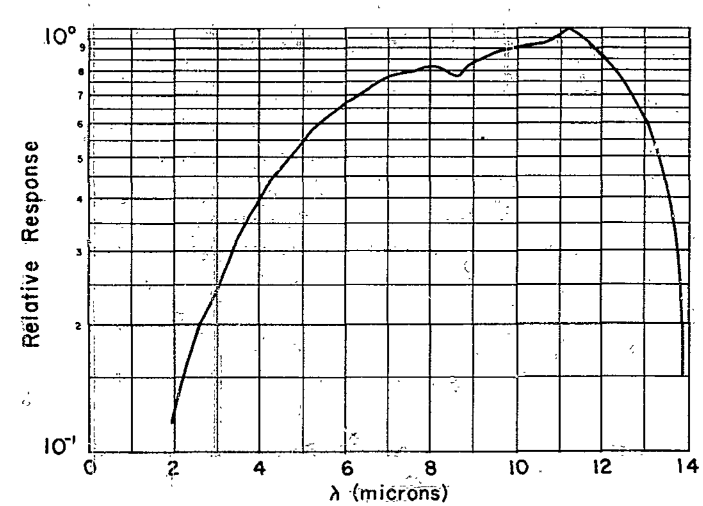
Type	Ge (Hg-doped)
Shape of sensitive area (cm)	0.1 diam.
Area (cm^2)	7.8×10^{-3}
Dark resistance (ohms)	5.4×10^{4}
Dynamic resistance (ohms)	---
Field of view	85°
Window material	Irtran II

CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	860
Noise bandwidth (cps)	5
Cell temperature (°K)	4
Cell current for 860-cps data (μa)	250
Cell current for D^*_{mm} (μa)	400
Load resistance (ohms)	5.0×10^{4}
Transformer	---
Relative humidity (%)	22
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only

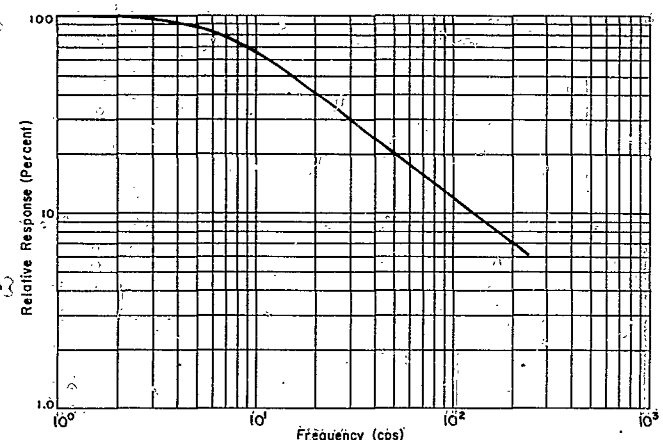


FIELD OF VIEW

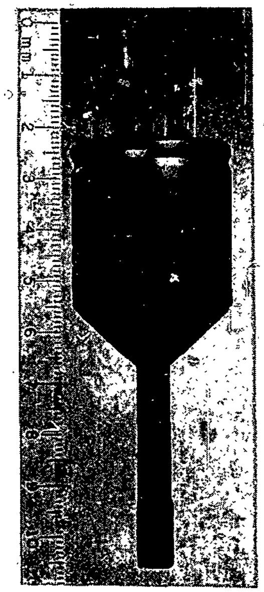


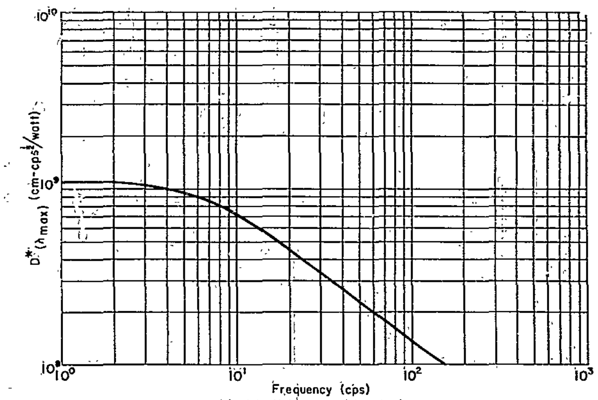
SPECTRAL RESPONSE

Santa Barbara Research Center Cell 22-8, Ge
Data Sheet No. 800-B, April 1964

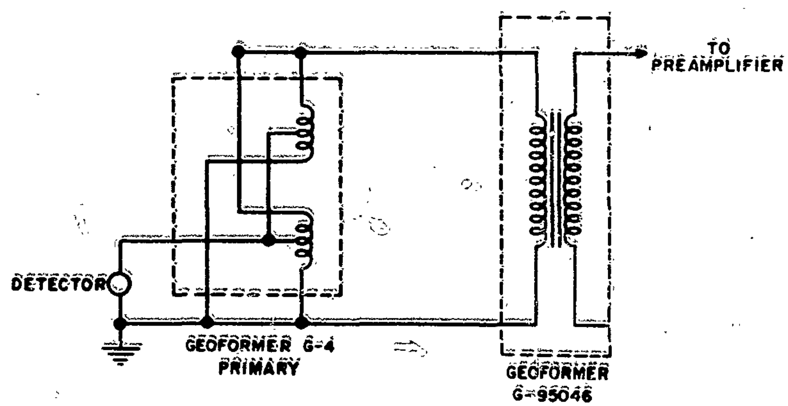


FREQUENCY RESPONSE

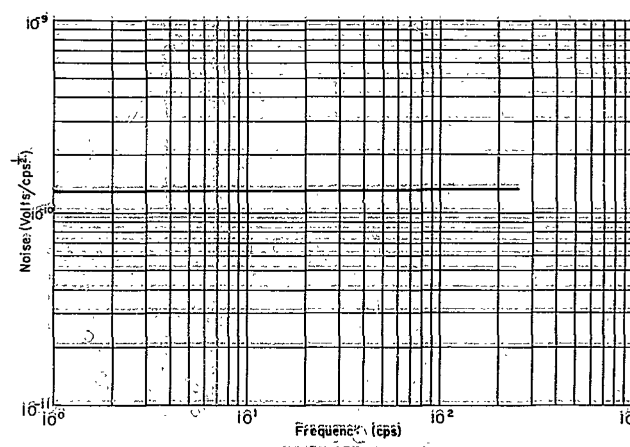




DETECTIVITY VS FREQUENCY



INPUT CIRCUIT FOR NOISE MEASUREMENTS



NOISE SPECTRUM

Beckman Instruments Cell 2352, Thermocouple
Data Sheet No. 801-A, December 1963

TEST RESULTS

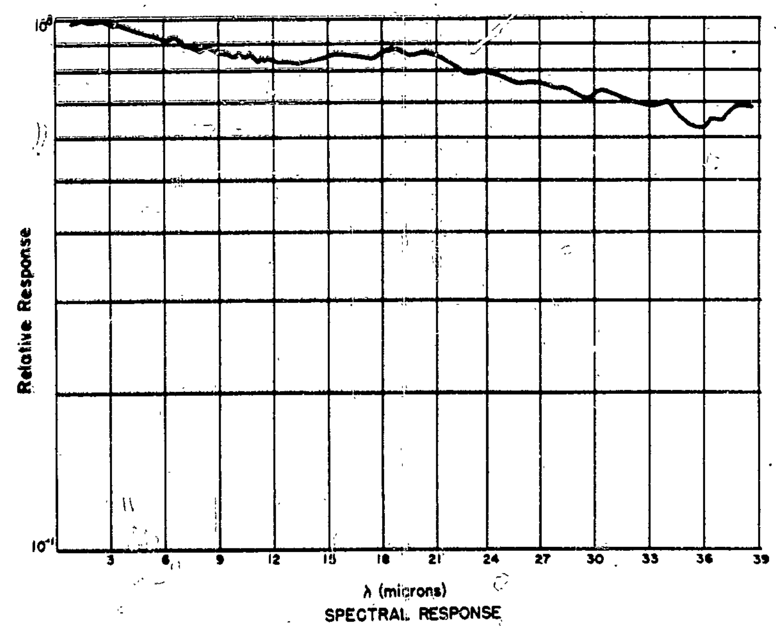
R (volts/watt) (500, 10)	1.1
H_N (watts/cps$^{\frac{1}{2}}$·cm^2) (500, 10)	1.9×10^{-8}
P_N (watts/cps$^{\frac{1}{2}}$) (500, 10)	1.3×10^{-10}
D^* (cm·cps$^{\frac{1}{2}}$/watt) (500, 10)	6.5×10^{8}
Responsive time constant (μsec)	1.9×10^{4}
$\frac{R_{\lambda max}}{R_{bb}}$	1.1
Peak wavelength (μ)	1.8
Peak detective modulation frequency (cps)	< 2
D^*_{mm} (cm·cps$^{\frac{1}{2}}$/watt)	1.1×10^{9}

CELL DESCRIPTION

Type	Thermocouple
Shape of sensitive area (cm)	0.033 × 0.208
Area (cm^2)	6.86×10^{-3}
Dark resistance (ohms)	---
Dynamic resistance (ohms)	1.0
Field of view	---
Window material	CsI

CONDITIONS OF MEASUREMENT

Blackbody temperature (°K)	500
Blackbody flux density (μwatts/cm^2, rms)	9.0
Chopping frequency (cps)	10
Noise bandwidth (cps)	0.3
Cell temperature (°K)	296
Cell current for 10-cps data (μa)	---
Cell current for D^*_{mm} (μa)	---
Load resistance (ohms)	---
Transformer	Geoformer G-4 and G95046
Relative humidity (%)	29
Responsive plane (from window)	---
Ambient temperature (°C)	23
Ambient radiation on detector	296°K only



Beckman Instruments Cell 2352, Thermocouple
Data Sheet No. 801-B, December 1963

APPENDIX

DEFINITIONS OF SYMBOLS AND TERMS

A = adopted sensitive area of the detector in cm^2

f = modulation frequency of the radiation incident on the detector

Δf = frequency bandwidth of the electrical measuring system in cps

J = rms value of the fundamental component of the radiant energy flux density, in watts/cm^2

N = rms noise voltage

R_0 = maximum response

R_ω = response as a function of $\omega = 2\pi f$

$\frac{R_{\lambda max}}{R_{bb}}$ = ratio of the responsivity at the peak wavelength to the responsivity to blackbody radiation

V = rms value of the fundamental component of the signal voltage as measured with the entire surface of the detector exposed

T, responsive time constant. When the photon-excited carriers in the semiconductor have a simple decay mechanism, the response to a sinusoidal varying signal may be given by

$$R_\omega/R_0 = (1 + \omega^2 T^2)^{-\frac{1}{2}}$$

The responsive time constant (T) is calculated from the frequency response. It will be noted that the load resistance used in each case is given on the frequency response curve.

R. The responsivity (R) is defined as the ratio of the rms value of the fundamental component of the signal voltage to the rms value of the fundamental component of the incident radiation power:

$$R = V/JA$$

The units of R are volts/watt.

H_N. The noise equivalent irradiance (H_N) is defined as the minimum radiant flux density necessary to give a signal-to-noise ratio of 1 when the noise is normalized to unit bandwidth:

$$H_N = JN/V \cdot \Delta f^{\frac{1}{2}}$$

The units of H_N are watts/cps$^{\frac{1}{2}}$·cm^2.

P_N. The noise equivalent power (P_N) is defined as the minimum radiant flux necessary to give a signal-to-noise ratio of 1 when the noise is normalized to unit bandwidth:

$$P_N = JNA/V \cdot \Delta f^{\frac{1}{2}}$$

The units of P_N are watts/cps$^{\frac{1}{2}}$.

D*. D-star is defined[1] as the detectivity normalized to unit area and unit bandwidth. Detectivity is the signal-to-noise ratio produced with unit radiant flux incident on the detector:

$$D^* = A^{\frac{1}{2}}/P_N$$

The units of D* are cm·cps$^{\frac{1}{2}}$/watt.

D^*_{mm} is defined as D-star at the peak wavelength, the optimum bias value, and the peak detective modulation frequency.

Calibration. The gain of the electrical system is calibrated by injecting a known voltage in series with the detector being tested. This is accomplished by means of a small resistor placed between the detector ground terminal and the system ground. Thus, the detector signal and noise voltages are referred to the detector terminals and to an infinite load impedance. The detector noise is corrected for amplifier noise.

---

[1] R. Clark Jones, "Methods of Rating the Performance of Photoconductive Cells," Proceedings of IRIS, Vol. 2, No. 1, June 1957.

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